

Eradication of Methicillin resistant *Staph aureus* (MRSA) and Methicillin sensitive *Staph aureus* (MSSA) Prior to Inpatient Surgery



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Introduction:

Methicillin-resistant *Staphylococcus aureus* (MRSA) and Methicillin-sensitive *Staphylococcus aureus* (MSSA) are isolates of *Staph aureus*. MRSA has acquired genes encoding antibiotic resistance to penicillins, including methicillin and other narrow-spectrum β -lactamase-resistant penicillin antibiotics. (1) MRSA occurs most frequently among patients who undergo surgical procedures, patients who have weakened immune systems, undergo invasive medical procedures, and patients being treated in hospitals and healthcare facilities. MRSA in healthcare settings commonly causes serious and potentially life-threatening infections, such as pneumonia, bloodstream infections, and surgical site infections.

Staphylococcus aureus became methicillin resistant by acquiring a *mecA* gene.(3) Recent outbreaks of CA-MRSA appear to be caused by isolates that also carry genes for Panton-Valentine leukocidin (PVL), a toxin that is known to cause lysis of white blood

cells. (4) However, the National Institute of Allergy and Infectious Diseases (NIAID) published a recent report that described proteins in drug-resistant strains of the *Staphylococcus aureus* are novel members of the phenol-soluble modulins (PSM) protein family. They attract and then destroy protective human white blood cells and essentially eliminate the immune defense mechanisms against CA-MRSA. The production of the proteins was typically higher in CA-MRSA strains known for severe virulence. (5).

Worldwide, an estimated 2 billion people carry some form of *S. aureus*; of these, up to 53 million (2.7% of carriers) are thought to carry MRSA. In the United States, 95 million carry *S. aureus* in their noses; of these 2.5 million (2.6% of carriers) carry MRSA. (6) Most CA-MRSA isolates were associated with clinically relevant infections, and 23% of patients required hospitalization. (7)

In the USA, reports have been increasing of outbreaks of MRSA colonization and infection through skin contact in locker rooms and gymnasiums, even among healthy populations. (8) A 2007 study found that 4.6% of patients in US healthcare facilities were infected or colonized with MRSA. (9)

Colonization indicates the presence of the organism without symptoms of illness. Colonization can occur in the nares, trachea, skin folds, rectum, or in an open wound such as decubitus ulcer. *S. aureus* permanently colonizes the anterior nares of about 20% to 30% of the general population. (10)

The Society for Healthcare Epidemiology of America (SHEA) recommended routine surveillance cultures at the time of admission to the hospital for patients at high risk for carriage of MRSA. SHEA also noted that rates of MRSA colonization might be higher among patients who have previously spent 15 days in an institutional setting, including long-term or acute care centers. (11)

The New England Baptist Hospital noticed an increase in community-acquired MRSA isolated detected by the infection control surveillance system and an increase in MRSA surgical site infection in 2005. In the fall of 2005, the healthcare-acquired isolates were sent to a reference laboratory for pulse field gel electrophoresis (PFGE) to determine if the strains were related, indicating nosocomial transmission. Results showed that the isolates were not related and were common strains in the community.

In January 2006, the Senior Vice President of Patient Care Services developed a white paper for the Board of Trustees and Administration describing the epidemiology of MRSA and recommended measures to control its spread. This included active surveillance cultures, more stringent infection precaution techniques, control of certain antibiotics, environmental controls and decolonization treatment to reduce colonization in the nares and body sites.

In February 2006, one hundred and thirty three patients had their nares cultured in the operating room. Results showed that 29% were carriers of MSSA and 5% were positive for MRSA. This prompted the administration and Infection Control Committee to

recommend an eradication program aimed at eliminating colonization prior to inpatient orthopedic surgery.

In July 2006, the hospital instituted an active surveillance and eradication program. The eradication program was implemented in the prescreening process and included early identification of carriers using rapid polymerase chain reaction (PCR) technology, decolonization treatment and adjustment of surgical prophylaxis. All inpatient surgeries were screened and those with positive results for MRSA and MSSA were treated. Surgical site infections due to MRSA and MSSA were monitored and reported to the infection control committee and administration on a monthly basis.

Program Implementation

The Infection Control Committee recommended implementation of an MSSA/MRSA eradication program to reduce nasal colonization in patients undergoing inpatient surgery and treat MRSA positive screens with Vancomycin for surgical prophylaxis

Administrative support was elicited by the Senior Vice President of Patient Care Services to fund a program, which would include obtaining nasal screens with rapid polymerase chain reaction (PCR) technology that would provide 2-hour results for MRSA and one day for MSSA.

The Infection Control Committee in January 2006 - recommended a pilot study be conducted during February on all spine surgeries. The study would involve anonymous nares surveillance cultures obtained at the time of surgery to ascertain the rate of MRSA/MSSA colonization. The reason for the selection of spine surgery was the high proportionate of surgical site infections occurring in this surgical population. 133 patients were cultured (nares) and 38 were positive for MSSA (29%) and 5 were MRSA positive (4%). Because the MRSA patients were unknown, no precautions were used in the OR and on the nursing units. In addition, they only received Cefazolin surgical prophylaxis, which is not active against MRSA.

On January 25, 2006, Diane Gulczynski, RN, MS, Senior VP, prepared and distributed a report on the problem of MRSA in healthcare settings and eradication procedures to be considered in our surgical population. The report called for active surveillance cultures, the purchase of rapid MRSA/MSSA test equipment for the micro lab, administration of mupirocin ointment (e.g. Bactroban) for 5 days preoperatively to reduce nasal colonization rates, treatment of MRSA positive patients with Vancomycin for surgical prophylaxis, and other control measure recommendations.

Diane submitted the report to the NEBH Executive Team and Board of Trustees and received approval for funding of an MRSA/MSSA eradication program. She revised the original report and distributed an update to the Infection Control Committee on Feb 15, 2006.

The Infection Control Committee formed a Task Force. The charge was to discuss the development of a protocol for the eradication of MRSA and MSSA in the prescreening

period and appropriate surgical prophylaxis and precautions in the postop period. The Task Force met in March 2006 and discussed possible action plans.

Additional subgroups met:

- Microbiology Laboratory Subgroup met in March to discuss the implications and needs of the microbiology laboratory.
- The Prescreening Unit (PASU) formed a subgroup to discuss their implications and needs.
- A hospital-wide subgroup met in April to discuss the implications and needs of Patient Access, Continuing Care, Patient Education, Pharmacy, Operating Room, Bond Center, and Nursing.
- Information Systems subgroup met in April to discuss the implications and needs of Information Systems
- The expanded Task Force met in April and recommended the following action be done before undertaking the complete active surveillance and treatment plan:
 - Institute a pilot study on the spine service starting in July 2006 to work out the procedural steps to the program.
 - The Microbiology Lab filled the new position to handle the new PCR equipment.
 - PASU filled a new position for the MRSA Coordinating Technician who would obtain the nares screens, educate the patient and facilitate communication of positive results.

In September 2006, the program was successfully implemented for all inpatient surgeries and the task force continued to meet on a weekly basis to solve problems and facilitate communication.

Program Overview:

An MRSA and MSSA screening and eradication program was implemented in the presurgical screening unit (PASU) in July 2006. The program included:

- 1) collection of a nares screen,
- 2) identification and notification of positives
- 3) treatment with 2% mupirocin ointment to each nostril twice a day
- 4) daily bathing with 2% chlorhexidine wash
- 5) education on MRSA and MSSA and hand hygiene
- 6) re-culture of MRSA positive patients
- 7) use of contact precautions in operating room
- 8) use of Vancomycin for MRSA positive patients during surgical prophylaxis.

The PASU hired a medical technician /(MT) to collect the specimens, educate the patients and family members, notify the positive patients, and the surgeons, operating room staff and infection control. The MT instructed the patient to fill the prescription for

2% mupirocin and purchase 2% chlorhexidine and initiate the decolonization protocol. The MRSA positive patients were required to return for a second screen or to have one done by their PCP and results faxed to the PASU. A follow-up phone call was completed by the MT to all MRSA and MSSA positive patients to assure compliance with the stated protocol.

Patient education included:

1. Hand hygiene brochure instructing the patient and family of the importance of personal hygiene and empowering the patients to ask healthcare workers if they have washed their hands prior to caring for them.
2. MRSA/MSSA Eradication brochure, which included *information about Staph aureus*, the eradication program and how to prevent transmission.
3. A prescription for mupirocin ointment

If a patient was MRSA positive, a unique screen labeled MRSA-SCR was entered into the hospital's medical record system to flag the patient for contact precautions and the need for Vancomycin use at the time of surgery. A color-coded label affixed to the medical record in PASU was also used as a back up system for patient identification and positive MRSA patients were added to an online data list.

Results

From July 17, 2006 through September 30, 2007, 7019 patients were screened; 1588 (23%) were MSSA positive and 309 (4%) were MRSA positive. Repeat nasal screens were obtained from MRSA patients prior to surgery and revealed 78% eradication. In the cohort of positive screens, there were 4/1588 MSSA infections (0.2%) and 4/309 MRSA infections (1.3%).

As a comparison, in a group of historical controls of inpatient surgeries in 2005, there were 24 *Staph aureus* surgical site infections in 6344 (0.4%). In 2007 there were 13 *Staph aureus* infections in 7019-screened patients (0.2%), demonstrating a 50% reduction in surgical site infections due to *Staph aureus*.

Overall infection rates over the past 5 years have shown a steady decline, but it is clear the 2006 eradication program was very instrumental in reducing the rates to a low level.

YEAR	#SSI	MRSA	MSSA	%	Orthopedic SSI Rate
FY03	63	13	27	63%	0.7
FY04	60	13	23	60%	0.6
FY05	49	8	19	55%	0.5
FY06	46	10	15	54%	0.5
FY07	39	5	8	33%	0.4

Program Cost:

The implementation costs were roughly \$400,00, which included ~\$100,000 for two full-time positions (microbiologist and medical technician), ~ \$60,000 for molecular diagnostic equipment, ~ \$40.00 per test for > 6000 inpatient surgeries.

Conclusions:

We have successfully implemented an MSSA and MRSA eradication program for all inpatient surgeries during the prescreening process. It has allowed for early identification of patients with MSSA and MRSA, decolonization treatment, and appropriate surgical prophylaxis for MRSA. Since implementation we have documented a reduction in infections due to MSSA and MRSA. A multidisciplinary approach with strong administrative support and consistent communication was vital to the implementation of the program.

References:

1. Foster T (1996). *Staphylococcus*. In: *Barron's Medical Microbiology (Barron S et al, eds.)*, 4th ed., Univ of Texas Medical Branch.
2. Okuma K, Iwakawa K, Turnidge J, et al (2002). "Dissemination of new methicillin-resistant *Staphylococcus aureus* clones in the community". *J Clin Microbiol* 40 (11): 4289-94.
3. Guignard B, Entenza JM, Moreillon P (2005). "Beta-lactams against methicillin-resistant *Staphylococcus aureus*". *Curr Opin Pharmacol* 5 (5): 479-89.
4. Miller L, Perdreau-Remington F, Rieg G, Mehdi S, Perlroth J, Bayer A, Tang A, Phung T, Spellberg B (2005). "[Necrotizing fasciitis caused by community-associated methicillin-resistant *Staphylococcus aureus* in Los Angeles](#)". *N Engl J Med* 352 (14): 1445-53.
5. Nature Medicine – November 2007
6. Graham P, Lin S, Larson E (2006). "A U.S. population-based survey of *Staphylococcus aureus* colonization". *Ann Intern Med* 144 (5): 318-25.
7. Voyich JM, Otto M, Mathema B, Braughton KR, Whitney AR, Welty D, Long RD, Dorward DW, Gardner DJ, Lina G, Kreiswirth BN, DeLeo FR (2006). "[Is Pantone-Valentine leukocidin the major virulence determinant in community-associated methicillin-resistant *Staphylococcus aureus* disease?](#)". *J Infect Dis* 194 (12): 1761-70.
8. Jernigan JA, Arnold K, Heilpern K, Kainer M, Woods C, Hughes JM (2006-05-12). "[Methicillin-resistant *Staphylococcus aureus* as community pathogen](#)". *Symposium on Community-acquired Methicillin-resistant Staphylococcus aureus (Atlanta, Georgia, USA)*. Cited in *Emerg Infect Dis*, Centers for Disease Control and Prevention.
9. Charbonneau P, Parienti J, Thibon P, Ramakers M, Daubin C, du Cheyron D, Lebouvier G, Le Coutour X, Leclercq R (2006). "Fluoroquinolone use and methicillin-resistant *Staphylococcus aureus* isolation rates in hospitalized patients: a quasi experimental study". *Clin Infect Dis* 42 (6): 778-84
10. [Association for Professionals in Infection Control & Epidemiology \(2007-06-25\). National Prevalence Study of Methicillin-Resistant *Staphylococcus aureus* \(MRSA\) in U.S. Healthcare Facilities.](#)

11. SHEA Guideline for Preventing Nosocomial Transmission of Multidrug Resistant Strains of *Staphylococcus aureus* and *Enterococcus*. Infection Control and Hospital Epidemiology. May , 2003.